[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. ; Notice No.]

RIN: 2120-

Interaction of Systems and Structures

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rulemaking.

SUMMARY: This notice proposes to revise the design standards for transport category airplanes equipped with systems that directly or as a result of a failure or malfunction would affect the structural performance of the airplane. This action would incorporate into the regulations the latest criteria developed for special conditions used in the certification of airplanes equipped with fly-by-wire and active flight control systems. This action would also relieve a burden on industry by eliminating differences between the Federal Aviation Regulations (FAR) and European Joint Airworthiness Regulations (JAR).

DATES: Comments must be received on or before [insert date 90 days after date of publication in the Federal Register].

ADDRESS: Comments on this proposal may be mailed in triplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket (AGC-10), Docket No. , 800 Independence Avenue SW., Washington DC 20591; or delivered in triplicate to: Room 915G, 800 Independence Avenue SW., Washington, DC 20591. Comments delivered must be marked: Docket No. . Comments may also be submitted electronically to nprmcmts@mail.hq.faa.gov. Comments may be examined in room 915G weekdays, except Federal holidays, between 8:30 a.m. and 5:00 p.m. In addition, the FAA is maintaining an information docket of comments in the Transport Airplane Directorate (ANM-100), FAA, 1601 Lind Avenue SW., Renton, WA 98055-4056. Comments in the information docket may be examined weekdays, except Federal holidays, between 7:30 a.m. and 4:00 p.m.

FOR FURTHER INFORMATION CONTACT: James Haynes, FAA Airframe and Propulsion Branch (ANM-112), Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, WA 98055-4056; telephone (206) 227-2131.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in the proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to the environmental, energy or economic impact that might result from adoption of proposals contained in this notice are invited. Substantive comments should be accompanied by cost estimates. Commenters should identify the regulatory docket or notice number and submit comments in triplicate to the Rules Docket addressed specified above. All comments will be considered by the Administrator before taking action on the proposed rulemaking. The proposals contained in this notice may be changed in light of comments received. All comments will be available in the Rules Docket, both before and after the closing date for comments, for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerning this rulemaking will be filed in the docket. Commenters wishing the FAA to acknowledge receipt of their comments must submit with those comments a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. ." The postcard will be date/time stamped and returned to the commenter.

Availability of the NPRM

An electronic copy of this document may be downloaded using a modem and suitable communications software from the FAA regulations section of the Fedworld electronic bulletin board service (telephone: 703-321-3339), the Federal Register's electronic bulletin board service (telephone: 202-512-1661), or the FAA's Aviation Rulemaking Advisory Committee Bulletin Board service (telephone: 202-267-5984).

Internet users may reach the FAA's web page at http://www.faa.gov or the Federal Register's web page at http://www.access.gpo/su_docs for access to recently published rulemaking documents.

Any person may obtain a copy of this NPRM by submitting a request to the Federal Aviation Administration, Office of Rulemaking, ARM-1, 800 Independence Avenue SW., Washington, D.C. 20591, or by calling (202) 267-9680. Communications must identify the notice number of this NPRM. Persons interested in being placed on a mailing list for future rulemaking documents should also request a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedures.

Background

Active flight control systems are capable of providing automatic responses to external inputs from sources other than the pilots. Active flight control systems have been expanded in function, effectiveness, and reliability to the point that fly-by-wire flight controls, without a manual backup system in the event of system failures, are becoming standard equipment on larger transport airplanes. As a result of these advancements in flight controls technology, the current safety standards contained in 14 CFR part 25 do not provide an adequate basis to address an acceptable level of safety for airplanes equipped with these advanced systems. Instead, certification of these systems has been achieved by issuance of special conditions under the provisions of 14 CFR section 21.16.

For example, stability augmentation systems (SAS), and to a lessor extent load alleviation systems (LAS), have been used on transport airplanes for many years. Past approvals of these systems were based on individual findings of equivalent level of safety with existing rules and on special conditions. An advisory circular (AC 25.672-1) was issued November 11, 1983 that provided an equivalent means of compliance under the provisions of § 21.21(b)(1) for SAS, LAS, flutter control systems (FCS), another type of active control system.

Although autopilots are also considered active control systems, typically their control authority has been limited such that the consequences of system failures could be readily counteracted by the pilot. Now, autopilot functions are integrated into the primary flight controls and are given sufficient control authority to maneuver the airplane to its structural design limits. This advanced technology with its expanded authority requires a new approach to account for the interaction of control systems and structures.

The usual deterministic approach to defining the loads envelope contained in part 25 does not fully account for system effectiveness and system reliability. These automatic systems may be inoperative or may operate in a degraded mode with less than full system authority. Therefore, it is necessary to determine the structural factors of safety and operating margins such that the joint probability of structural failures due to application of loads during system malfunctions is not greater than that found in airplanes equipped with earlier technology control systems. To achieve this objective it is necessary to define the failure conditions with their associated frequency of occurrence in order to determine the structural factors of safety and operating margins that will ensure an acceptable level of safety.

Earlier automatic control systems usually provided two states, either fully functioning or a total loss of function. These conditions were readily detected by the flightcrew. The new active flight control systems have failure modes that allow the system to function in the degraded mode without full authority. This degraded mode is not readily detectable by the flightcrew. Therefore, monitoring systems are required on these new systems to provide an annunciation of a condition of degraded system capability.

In 1988, the FAA, in cooperation with the JAA and organizations representing the U.S. and European aerospace industries, began a process to harmonize the airworthiness requirements of the United States and the airworthiness requirements of the European authorities. The objective was to achieve common requirements for the certification of transport airplanes without a substantive change in the level of safety. Other airworthiness authorities such as Transport Canada also participated in this process.

In 1992, the harmonization effort was undertaken by the Aviation Regulatory Advisory Committee (ARAC). By notice in the Federal Register (58 FR 13819, March 15, 1993), the FAA chartered a working group of industry and government structural specialists of Europe, the U.S., and Canada. The harmonization effort has now progressed to the point that some specific proposals have been developed by the working group for the interaction of systems and structures requirements of part 25. These proposals have been adopted by ARAC and recommended to the FAA by letter dated [insert date submitted to the FAA]. This notice

contains the proposals necessary to achieve harmonization of the interaction of systems and structures requirements of part 25.

In this proposed revision, and in the current standards and regulations, the term "any" is used. Use of this term has traditionally been understood to require the applicant to address all items covered by the term, rather than addressing only a portion of the items. The use of the term "any" in this amendment continues this traditional understanding.

Discussion

This notice proposes to incorporate the safety requirements found necessary for airplanes equipped with active flight controls and fly-by-wire flight control systems except that the general philosophy of accounting for the impact of system failures on structural performance would be extended to include any system whose partial or complete failure, alone or in combination with other system partial or complete failures, would affect structural performance. The required structural factors of safety would be defined as a function of system reliability. This is an extension of the current philosophy that the airplane should be capable of continued safe flight and landing after specific failure events not shown to be extremely improbable.

Paragraph (e) of this proposal provides for the consideration of expected operational limits in the establishment of the appropriate safety factors. These limits are the expected maximum limits for dispatch in the failure condition and would be established consistent with experience on similar equipment in service.

In addition to providing requirements for static strength this notice proposes requirements that account for the effects of system failures on fatigue, damage tolerance, residual strength, deformation and aeroelastic stability. The impact of all combinations of system failures not shown to be extremely improbable need to be investigated.

This action should not have a significant economic impact on the manufacturers of new airplanes since it incorporates the criteria already applied by special conditions to new technology airplanes. Nor would it place a significant design burden on the applicant because there are many design options available including conventional control systems. This proposal would add a new

§ 25.302 and a new Appendix K to part 25 to incorporate these latest safety standards. It would also amend §§ 25.305 and 25.629 to make these rules compatible with the new § 25.302 rule.

Regulatory Evaluation Summary

Regulatory Evaluation Summary. Regulatory Flexibility Determination. and Trade Impact Assessment

Changes to federal regulations must undergo several economic analyses. First, Executive Order 12866 directs Federal agencies to promulgate new regulations or modify existing regulations only if the potential benefits to society outweigh the potential costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities. Finally, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. In conducting these assessments, the FAA has determined that this proposed rule: (1) would generate benefits exceeding its costs and is not "significant" as defined in Executive Order 12866; (2) is not "significant" as defined in DOT's Policies and Procedures; (3) would not have a significant impact on a substantial number of small entities; and (4) would lessen restraints on international trade. These analyses, available in the docket, are summarized below.

Regulatory Evaluation Summary

The proposed requirements would apply to future type certificated transport category airplanes and would not impose additional costs on manufacturers. The latest criteria developed for recent special conditions for fly-by-wire and active flight control systems would be incorporated into the FAR. The special conditions contain safety standards necessary to maintain a level of safety equivalent to that established in the FAR. Special conditions are never used as a means to increase the level of safety above that described by the certification basis of the airplane or product. Where special conditions are necessary in order to certify a product, it is not incumbent on the FAA to assess their cost-effectiveness. The cost-effectiveness of a novel or unique design is the responsibility of the applicant and is implicit in the applicant's design decision. Furthermore, it is unlikely that a unique design would become industry practice unless industry deemed it cost effective.

One manufacturer of part 25 small airplanes is concerned that, in order to prevent risk of new loads impacting a new type certification program in the test phase, it would have to make conservative assumptions on the Appendix K factors or extend the program to allow a design iteration which includes actual factors generated from known system failure probabilities. The FAA maintains that the current regulations already require system safety analyses that estimate system failure probabilities. The same manufacturer states that Appendix K would increase airplane weight. The FAA believes that compliance with Appendix K should result in a lighter airplane. The manufacturer also contends that it and other manufacturers currently provide the intent of proposed § 25.302 through compliance with the existing FAR. The FAA disagrees with this interpretation. Under the current regulations, in order to take advantage of any loads relief provided by any active control system, it is necessary to comply with either special conditions or findings of equivalent safety. In either case, compliance with standards equivalent to Appendix K would be required. There are no current part 25 regulations that provide the intent of § 25.302 unless supplemented with equivalent safety standards.

Another manufacturer of part 25 small airplanes indicates that the requirements of proposed Appendix K seem to also pertain to older mechanical systems and therefore may impose additional costs. The FAA notes that the proposed Appendix K requirements pertaining to such systems essentially reflect those of current §§ 25.671 (Control Systems, General) and 25.672 (Stability augmentation and automatic and power-operated systems), as well as those of §§ 25.1309 (Equipment, systems, and installations) and 25.1329 (Automatic pilot system). Consequently, no new costs would be imposed with respect to certification of mechanical systems.

Finally, by harmonizing the standards of the FAR and JAR, the proposed rule would yield cost savings by eliminating duplicate certification activities. One manufacturer of part 25 large airplanes estimates potential cost-savings of approximately $80,000 per type certification. Increased efficiency from codification of the proposed requirements, as opposed to continued reliance on special conditions, would supplement these benefits.

Based on the finding of no incremental costs imposed, coupled with the cost savings realizable from harmonization, the FAA has determined that the proposed rule is cost-beneficial.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by Government regulations. The RFA requires agencies to determine whether rules would have "a significant economic impact on a substantial number of small entities." FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, prescribes standards for complying with RFA requirements in FAA rulemaking actions. The Order defines "small entities" in terms of size thresholds, "significant economic impact" in terms of annualized cost thresholds, and "substantial number" as a number which is not less than eleven and which is more than one-third of the affected small entities.

The proposed rule would affect manufacturers of transport category airplanes produced under future new airplane type certifications. For airplane manufacturers, FAA Order 2100.14A specifies a size threshold for classification as a small entity as 75 or fewer employees. Since no part 25 airplane manufacturer has 75 or fewer employees, the proposed rule would not have a significant economic impact on a substantial number of small airplane manufacturers.

International Trade Impact Assessment

The proposed rule would have no adverse impact on trade opportunities for U.S. manufacturers selling airplanes in foreign markets and foreign manufacturers selling airplanes in the U.S. market. Instead, by harmonizing the standards of the FAR and the JAR, it would lessen restraints on trade.

Federalism Implications

The regulations proposed herein would not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this proposal would not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

International Compatibility

The FAA has reviewed corresponding International Civil Aviation Organization regulations and the regulations of the Joint Aviation Authorities, where they exist, and has identified no differences in these proposed amendments and the foreign regulations.

Paperwork Reduction Act

In accordance with the Paperwork Reduction Act of 1980 (Pub. L. 96-511), there are no requirements for information collection associated with this proposed rule.

Conclusion

Because the proposed changes to the loads requirements are not expected to result in substantial economic cost, the FAA has determined that this proposed rule would not be significant under Executive Order 12866. Because this is an issue that has not prompted a great deal of public concern, the FAA has determined that this action is not significant as defined in Department of Transportation Regulatory Policies and Procedures (44 FR 11034, February 25, 1979). In addition, since there are no small entities affected by this proposed rulemaking, the FAA certifies, under the criteria of the Regulatory Flexibility Act, that this proposed rule, if adopted, would not have a significant economic impact, positive or negative, on a substantial number of small entities. An initial regulatory evaluation of the proposed rule, including a Regulatory Flexibility determination and Trade Impact Analysis, has been placed in the docket. A copy may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

List of Subjects in 14 CFR part 25

Aircraft, Aviation safety, Reporting and Record keeping requirements.

The Proposed Amendments

Accordingly, the Federal Aviation Administration (FAA) proposes to amend 14 CFR part 25 of the Federal Aviation Regulations (FAR) as follows:

PART 25-AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

1. The authority citation of Part 25 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

2. By adding a new paragraph § 25.302 to read as follows:

§ 25.302 Interaction of systems and structures.

For airplanes equipped with systems that affect structural performance, either directly or as a result of a failure or malfunction, the influence of these systems and their failure conditions must be taken into account when showing compliance with the requirements of Subparts C and D. Appendix K of this part must be used to evaluate the structural performance of airplanes equipped with these systems.

3. By adding a new Appendix K to read as follows:

APPENDIX K TO PART 25 - INTERACTION OF SYSTEMS AND STRUCTURES

K25.1 General.

The following criteria must be used for showing compliance with § 25.302 for airplanes equipped with flight control systems, autopilots, stability augmentation systems, load alleviation systems, flutter control systems, and fuel management systems. If this appendix is used for other systems, it may be necessary to adapt the criteria to the specific system.

(a) The criteria defined herein only address the direct structural consequences of the system responses and performances and cannot be considered in isolation but should be included in the overall safety evaluation of the airplane. These criteria may in some instances duplicate standards already established for this evaluation. These criteria are only applicable to structure whose failure could prevent continued safe flight and landing. Specific criteria that define acceptable limits on handling characteristics or stability requirements when operating in the system degraded or inoperative mode are not provided in this appendix.

(b) Depending upon the specific characteristics of the airplane, additional studies may be required that go beyond the criteria provided in this appendix in order to demonstrate the capability of the airplane to meet other realistic conditions such as alternative gust or maneuver descriptions for an airplane equipped with a load alleviation system.

(c) The following definitions are applicable to this appendix.

Structural performance: Capability of the airplane to meet the structural requirements of Part 25.

Flight limitations: Limitations that can be applied to the airplane flight conditions following an in-flight occurrence and that are included in the flight manual (e.g., speed limitations, avoidance of severe weather conditions, etc.).

Operational limitations: Limitations, including flight limitations, that can be applied to the airplane operating conditions before dispatch (e.g., fuel, payload and Master Minimum Equipment List limitations).

Probabilistic terms: The probabilistic terms (probable, improbable, extremely improbable) used in this appendix are the same as those used in § 25.1309.

Failure condition: The term failure condition is the same as that used in § 25.1309, however this appendix applies only to system failure conditions that affect the structural performance of the airplane (e.g., system failure conditions that induce loads, change the response of the airplane to inputs such as gusts or pilot actions, or lower flutter margins).

K25.2 Effects of Systems on Structures.

(a) General. The following criteria will be used in determining the influence of a system and its failure conditions on the airplane structure.

(b) System fully operative. With the system fully operative, the following apply:

(1) Limit loads must be derived in all normal operating configurations of the system from all the limit conditions specified in Subpart C, taking into account any special behavior of such a system or associated functions or any effect on the structural performance of the airplane that may occur up to the limit loads. In particular, any significant nonlinearity (rate of displacement of control surface, thresholds or any other system nonlinearities) must be accounted for in a realistic or conservative way when deriving limit loads from limit conditions.

(2) The airplane must meet the strength requirements of part 25 (Static strength, residual strength), using the specified factors to derive ultimate loads from the limit loads defined above. The effect of nonlinearities must be investigated beyond limit conditions to ensure the behavior of the system presents no anomaly compared to the behavior below limit conditions. However, conditions beyond limit conditions need not be considered when it can be shown that the airplane has design features that will not allow it to exceed those limit conditions.

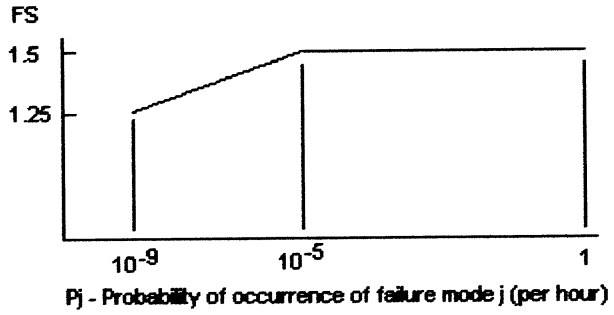
(3) The airplane must meet the aeroelastic stability requirements of § 25.629.

(c) System in the failure condition. For any system failure condition not shown to be extremely improbable, the following apply:

(1) At the time of occurrence. Starting from 1-g level flight conditions, a realistic scenario, including pilot corrective actions, must be established to determine the loads occurring at the time of failure and immediately after failure.

(i) For static strength substantiation, these loads multiplied by an appropriate factor of safety that is related to the probability of occurrence of the failure are ultimate loads to be considered for design. The factor of safety (F.S.) is defined in Figure 1.

Figure 1
factor of safety at the time of occurrence



(ii) For residual strength substantiation, the airplane must be able to withstand two thirds of the ultimate loads defined in subparagraph (c)(1)(i).

(iii) Freedom from aeroelastic instability must be shown up to the speeds defined in § 25.629(b)(2). For failure conditions that result in speed increases beyond V_C/M_C, freedom

from aeroelastic instability must be shown to increased speeds, so that the margins intended by § 25.629(b)(2) are maintained.

(iv) Failures of the system that result in forced structural vibrations (oscillatory failures) must not produce loads that could result in detrimental deformation of primary structure.

(2) For the continuation of the flight. For the airplane, in the system failed state and considering any appropriate reconfiguration and flight limitations, the following apply:

(i) The loads derived from the following conditions at speeds up to Vc, or the speed limitation prescribed for the remainder of the flight must be determined:

(A) the limit symmetrical maneuvering conditions specified in § 25.331 and in § 25.345.

(B) the limit gust and turbulence conditions specified in § 25.341 and in § 25.345.

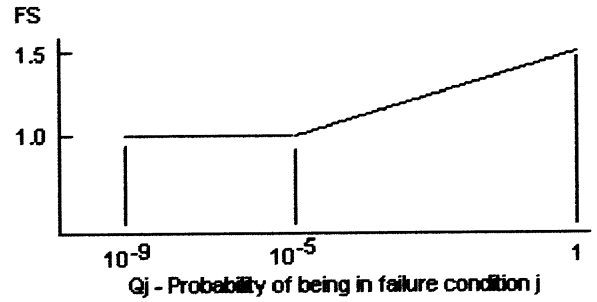
(C) the limit rolling conditions specified in § 25.349 and the limit unsymmetrical conditions specified in § 25.367 and § 25.427(b) and (c).

(D) the limit yaw maneuvering conditions specified in § 25.351.

(E) the limit ground loading conditions specified in § 25.473 and § 25.491.

(ii) For static strength substantiation, each part of the structure must be able to withstand the loads in subparagraph (2)(i) of this paragraph multiplied by a factor of safety depending on the probability of being in this failure state. The factor of safety is defined in Figure 2.

Figure 2
Factor of safety for continuation of flight



$Q_j = (T_j)(P_j)$ where:

T_j = Average time spent in failure condition j (in hours)

P_j = Probability of occurrence of failure mode j (per hour)

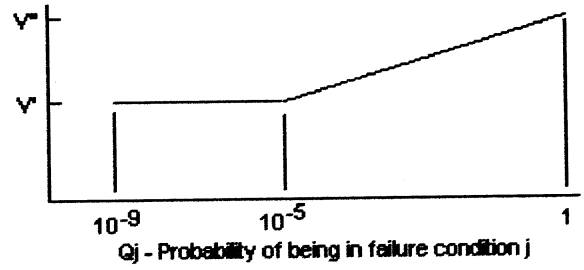
Note: If P_j is greater than 10^{-3}, per flight hour then a 1.5 factor of safety must be applied to all limit load conditions specified in Subpart C.

(iii) For residual strength substantiation, the airplane must be able to withstand two thirds of the ultimate loads defined in subparagraph (c) (2) (ii).

(iv) If the loads induced by the failure condition have a significant effect on fatigue or damage tolerance then their effects must be taken into account.

(v) Freedom from aeroelastic instability must be shown up to a speed determined from Figure 3. Flutter clearance speeds V' and V" may be based on the speed limitation specified for the remainder of the flight using the margins defined by § 25.629(b).

Figure 3
Clearance speed



V' = Clearance speed as defined by § 25.629(b)(2).

V" = Clearance speed as defined by § 25.629(b)(1).

$Q_j = (T_j)(P_j)$ where:

T_j = Average time spent in failure condition j (in hours)

P_j = Probability of occurrence of failure mode j (per hour)

Note: If P_j is greater than 10^{-3} per flight hour, then the flutter clearance speed must not be less than V".

(vi) Freedom from aeroelastic instability must also be shown up to V' in Figure 3 above, for any probable system failure condition combined with any damage required or selected for investigation by § 25.571(b).

(3) Consideration of certain failure conditions may be required by other Sections of this Part regardless of calculated system reliability. Where analysis shows the probability of these failure conditions to be less than 10^{-9}, criteria other than those specified in this paragraph may be used for structural substantiation to show continued safe flight and landing.

(d) Warning considerations. For system failure detection and warning, the following apply:

(1). The system must be checked for failure conditions, not extremely improbable, that degrade the structural capability below the level required by part 25 or significantly reduce the reliability of the remaining system. The flight crew must be made aware of these failures before flight. Certain elements of the control system, such as mechanical and hydraulic components, may use special periodic inspections, and electronic components may use daily checks, in lieu of warning systems to achieve the objective of this requirement. These certification maintenance requirements must be limited to components that are not readily detectable by normal warning systems and where service history shows that inspections will provide an adequate level of safety.

(2). The existence of any failure condition, not extremely improbable, during flight that could significantly affect the structural capability of the airplane and for which the associated reduction in airworthiness can be minimized by suitable flight limitations, must be signaled to the flightcrew. For example, failure conditions that result in a factor of safety between the airplane strength and the loads of Subpart C below 1.25, or flutter margins below V", must be signaled to the crew during flight.

e) Dispatch with known failure conditions. If the airplane is to be dispatched in a known system failure condition that affects structural performance, or affects the reliability of the remaining system to maintain structural performance, then the provisions of § 25.302 must be met for the dispatched condition and for subsequent failures. Flight limitations and expected operational limitations may be taken into account in establishing Qj as the combined probability of being in the dispatched failure condition and the subsequent failure condition for the safety margins in Figures 2 and 3. These limitations must be such that the probability of being in this combined failure state and then subsequently encountering limit load conditions is extremely improbable. No reduction in these safety margins is allowed if the subsequent system failure rate is greater than 1E-3 per hour.

4. By amending § 25.305 by revising paragraph (f) to read as follows:

§ 25.305 Strength and deformation.

* * * * *

(f) Unless shown to be extremely improbable, the airplane must be designed to withstand any forced structural vibration resulting from any failure, malfunction or adverse condition in the flight control system. These loads must be treated in accordance with the requirements of § 25.302.

5. By amending § 25.629 by revising paragraphs (a), (c), and (d)(2) and by adding a new paragraph (b)(3) to read as follows:

§ 25.629 Aeroelastic stability requirements.

(a) General. The aeroelastic stability evaluations required under this section include flutter, divergence, control reversal and any undue loss of stability and control as a result of structural deformation. The aeroelastic evaluation must include whirl modes associated with any propeller or rotating device that contributes significant dynamic forces. Compliance with this section must be shown by analysis, tests, or some combination thereof as found necessary by the Administrator.

(b) * * * *

(3) For failure conditions in those systems covered by § 25.302, the margins defined in Appendix K of this part apply.

(c) Balance weights. If balance weights are used, their effectiveness and strength, including supporting structure, must be substantiated.

(d) * * * *

(2) Any single failure in any flutter damper or flutter control system.

Issued in Washington DC., on

DC/Interact.doc